Utilization of Extracorporeal Pump during Local Intra-arterial Fibrinolysis in the Treatment of Acute Cerebral Arterial Occlusion

A Case Report

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Summary

Local intra-arterial fibrinolysis may improve the outcome of patients with ischemic cerebrovascular disease. A favorable prognosis is thought to be related to early re-establishment of blood flow into the affected brain. To minimize the time to revascularization during local intra-arterial fibrinolysis, we employed an extracorporeal pump to deliver oxygenated blood into the affected brain through a microcatheter. The patient, a 57-year-old man, showed disturbance of consciousness with left hemiparesis and was admitted to our hospital one hour after onset of symptoms. Cerebral angiography demonstrated an acute occlusion of the right middle cerebral artery, and the patient underwent local intra-arterial fibrinolysis with an extracorporeal pump. Oxygenated blood was successfully delivered through a microcatheter into the affected brain before recanalization. Subsequently, recanalization was obtained by intra-arterial fibrinolysis with a tissue plasminogen activator. The outcome of this patient was excellent. Thus, local intra-arterial thrombolysis with extracorporeal pump may be an effective method by which to increase the residual blood flow and widen the therapeutic window for fibrinolysis.

Introduction

Stroke is the third most common cause of death in Japan, and it has devastating sequelae for survivors and their families. A trial conducted by the National Institute of Neurological Disorders and Stroke in the United States successfully showed the benefit of intravenous administration of tissue plasminogen activator (tPA) in cases in which treatment was started within three hours of onset [1]. Stroke is now recognized as a medical emergency.

Local intra-arterial fibrinolysis is thought to be superior to intravenous thrombolysis, because it may achieve more complete recanalization with less fibrinolytic agent [2-9]. A favorable prognosis is reported to be associated with early re-establishment of blood flow into the affected brain by local intra-arterial fibrinolysis [3,6]. Recent advances in neuroradiographic techniques have made it possible to introduce a microcatheter into the distal site of the intra-arterial embolus without difficulty. To minimize the time to revascularization during local intra-arterial fibrinolysis, we employed an extracorporeal pump to deliver oxygenated blood through a microcatheter introduced into the distal site of occlusion prior to fibrinolysis. Here, we de-

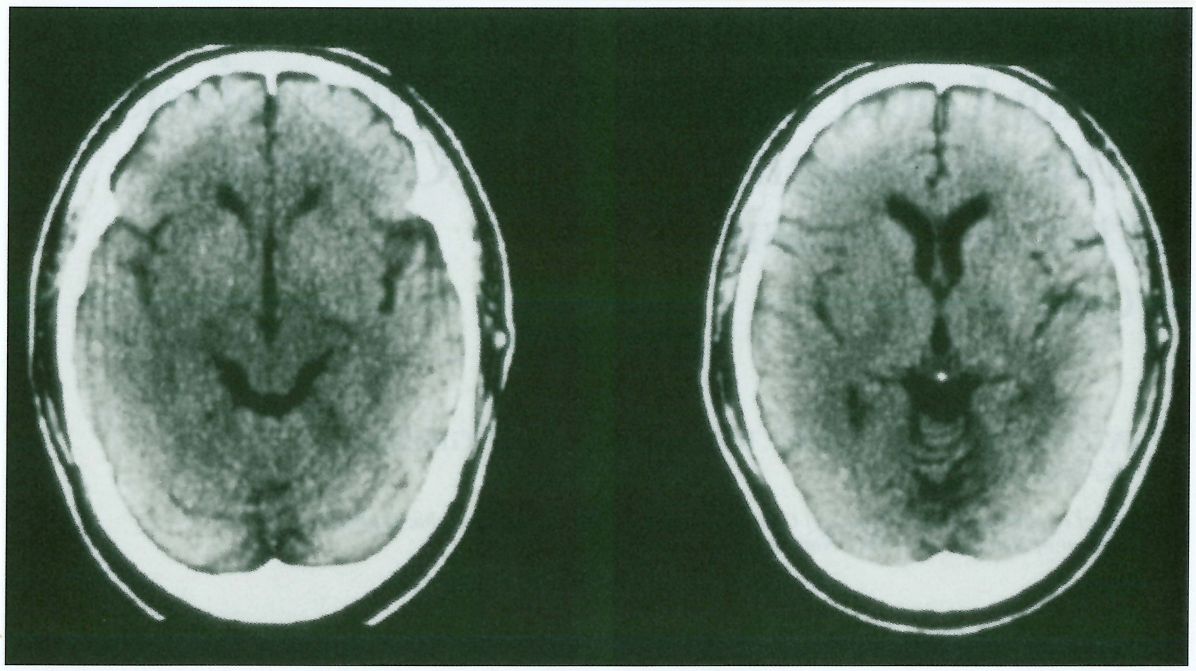

Figure 1 Computed tomography on admission, showing no low-density area.

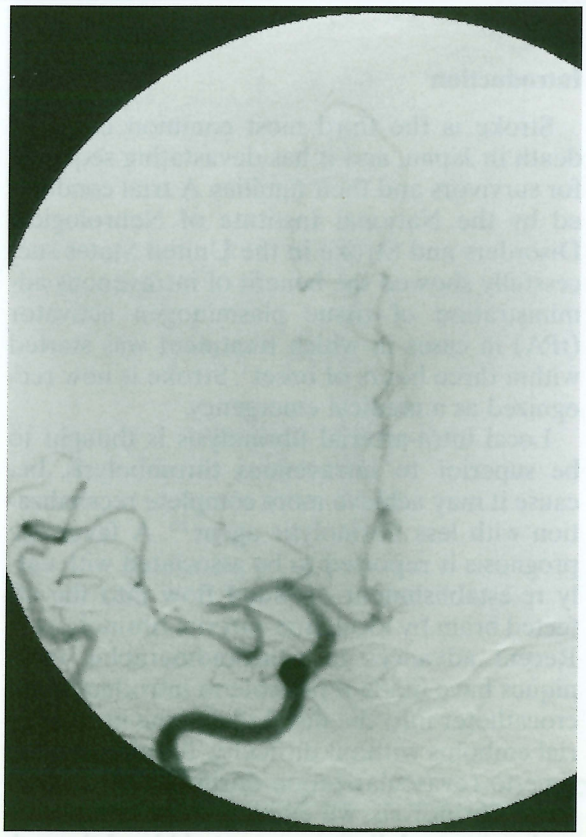

Figure 2 Anterior-posterior view of the right carotid angiogram, showing an occlusion of the right middle cerebral artery its M1 portion.

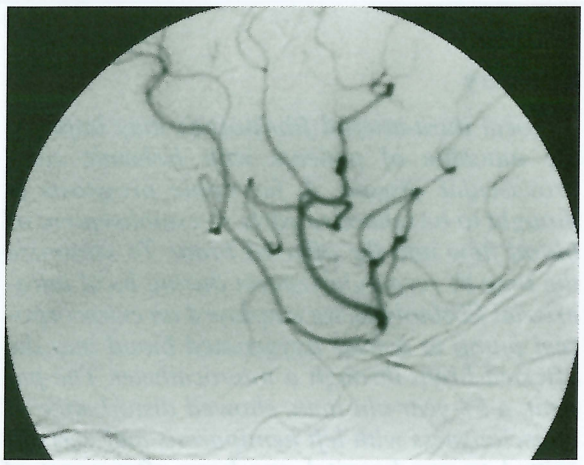

Figure 3 Cerebral angiogram (lateral view) during revascularization, showing the area of blood delivery from the microcatheter placed distal to the embolus.

scribe our clinical experience applying extracorporeal pump-assisted local intra-arterial fibrinolysis.

Case Report

A 57-year-old man suddenly developed disturbance of consciousness with left hemiparesis, and was transferred to our hospital by am-

bulance one hour after the onset of symptoms. This patient had a history of mitral valve replacement, and had been given an oral administration of warfarin. Computed tomographic (CT) scan of the brain on admission revealed no abnormality (figure 1). Angiography was performed directly from the femoral route. It demonstrated the embolic occlusion of the right middle cerebral artery at the M1 portion (figure 2), and local intra-arterial fibrinolysis with an extracorporeal pump was performed. The blood-collecting side of the extracorporeal pump is connected to the introducer inserted into the contralateral femoral artery. Heparin (5,000 Units) was administered intravenously. The Turbotracker 18 microcatheter (Target Therapeutics, Fremont, CA, USA) and the Dasher 14 microguidewire (Target Therapeutics, Fremont, CA, USA) were introduced into the distal portion of the embolus using endovascular treatment techniques. After confirmation that the microcatheter is past the embolus and at the more peripheral arteries, the blood-feeding side of the pump is connected to the microcatheter. In a preliminary study, we found that the Turbotracker 18 with a length of 150 cm delivered 15 ml/min of blood with 800 mmHg (about 2 atoms) of pump pressure.

Therefore, flow rate was adjusted to 15 ml/min of blood flow through the microcatheter. The area of revascularization was confirmed by injecting contrast medium into the microcatheter (figure 3). Intra-arterial fibrinolysis was performed using 1,600,000 IU of tPA from the guiding catheter and 1,600,000 IU of tPA from the microcatheter, respectively. In this patient, about 4 hours after onset, partial recanalization of the right middle cerebral artery was obtained (figure 4).

CT scan at one week after onset showed a small low density area (figure 5). The patient was discharged, and returned to his job without neurological deficit.

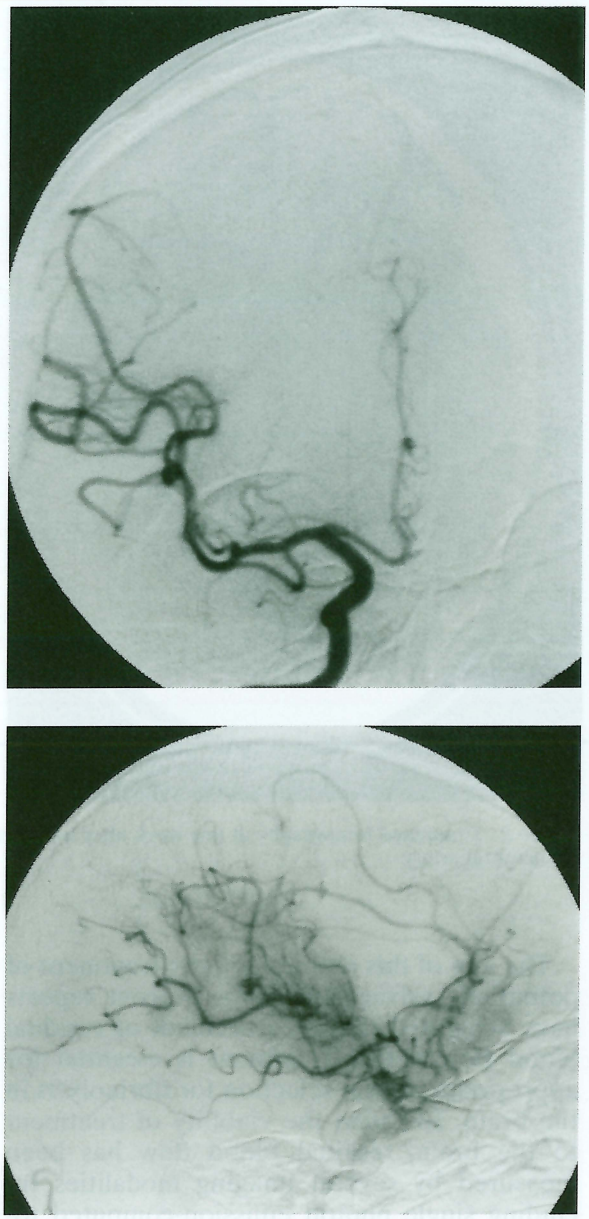

Figure 4 Anterior-posterior and lateral views of right carotid angiogram after fibrinolysis, showing partial recanalization of the middle cerebral arteries.

Discussion

The therapeutic time window in humans after the onset of ischemic symptoms is generally believed to be only several hours. However, the window could vary among individuals and may depend on the degree of collateral flow and metabolic status [10,11]. Ideally, the duration of the ischemia is shorter, and the residual blood flow in the territory of occluded vessels is greater, than the level at which the viability of neuronal cells is preserved [12]. Our new method enables the delivery of oxygenated blood into the ischemic area immediately after the introduction of a microcatheter, which may increase residual blood flow and lessen ischemic brain damage.

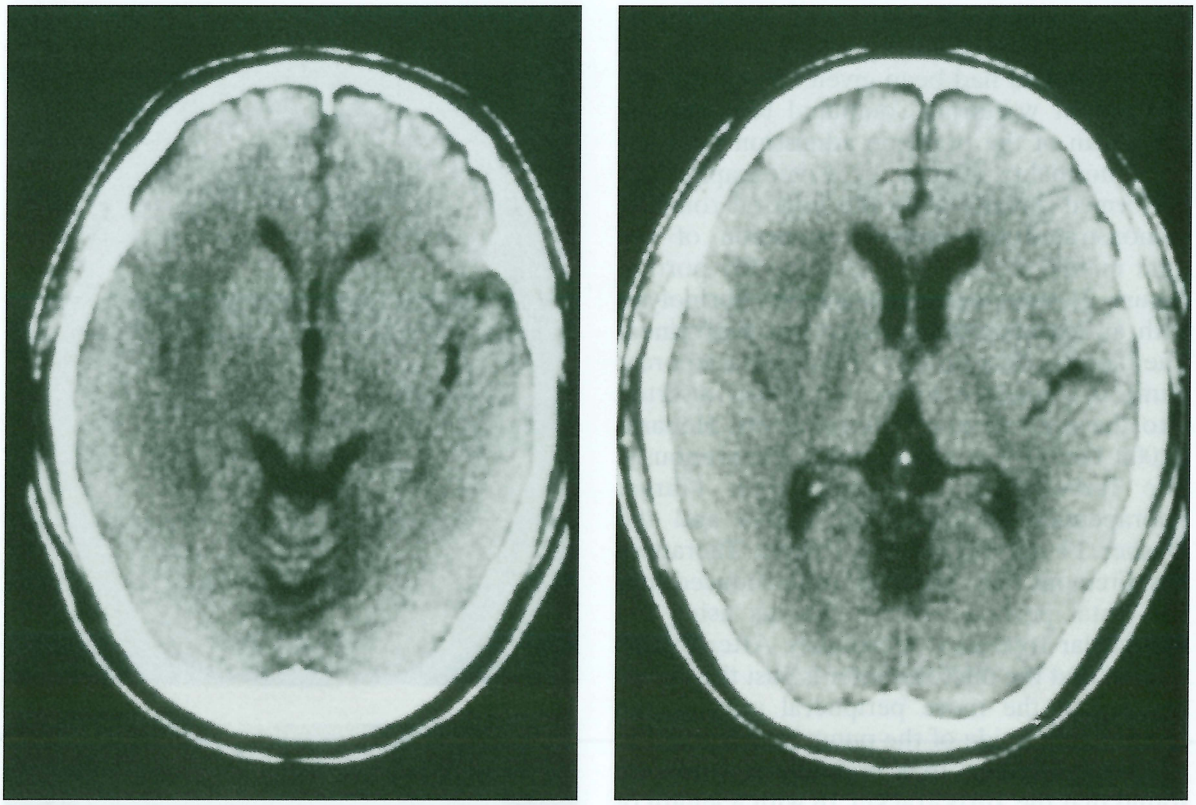

Figure 5 Computed tomography at one week after treatment, showing a small low-density spot in the territory of the middle cerebral artery.

The aim of this therapy is early treatment of potentially salvageable areas. Recent reports have suggested that measurement of residual blood flow before treatment is essential for appropriate patient selection for fibrinolysis in the brain. To assess the viability of treatment to the brain, residual blood flow has been measured by several imaging modalities including single photon emission-computed tomography [12-14], diffusion-weighted magnetic resonance (MR) images, and perfusion-weighted MR images [15-17].

However, these modalities may be too time-consuming in an emergent status. The method described here includes a way in which to examine the viability of affected brain tissue prior to fibrinolysis. In addition, improvement of neurological deficits may be observed after revascularization by the pump if damage to the affected brain tissue is reversible or if the tissue is salvageable.

There are several disadvantages to this method; the pump requires complicated circuit preparation, and hemolysis is possible due to high pump pressure during operation. Further investigation is needed to assess the efficacy of this method.

Our findings suggest that this new method may increase residual blood flow and widen the therapeutic window for fibrinolysis.

Conclusions

This new method of acute revascularization using extracorporeal is promising to increase the residual blood flow and widen the therapeutic window for fibrinolysis.

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